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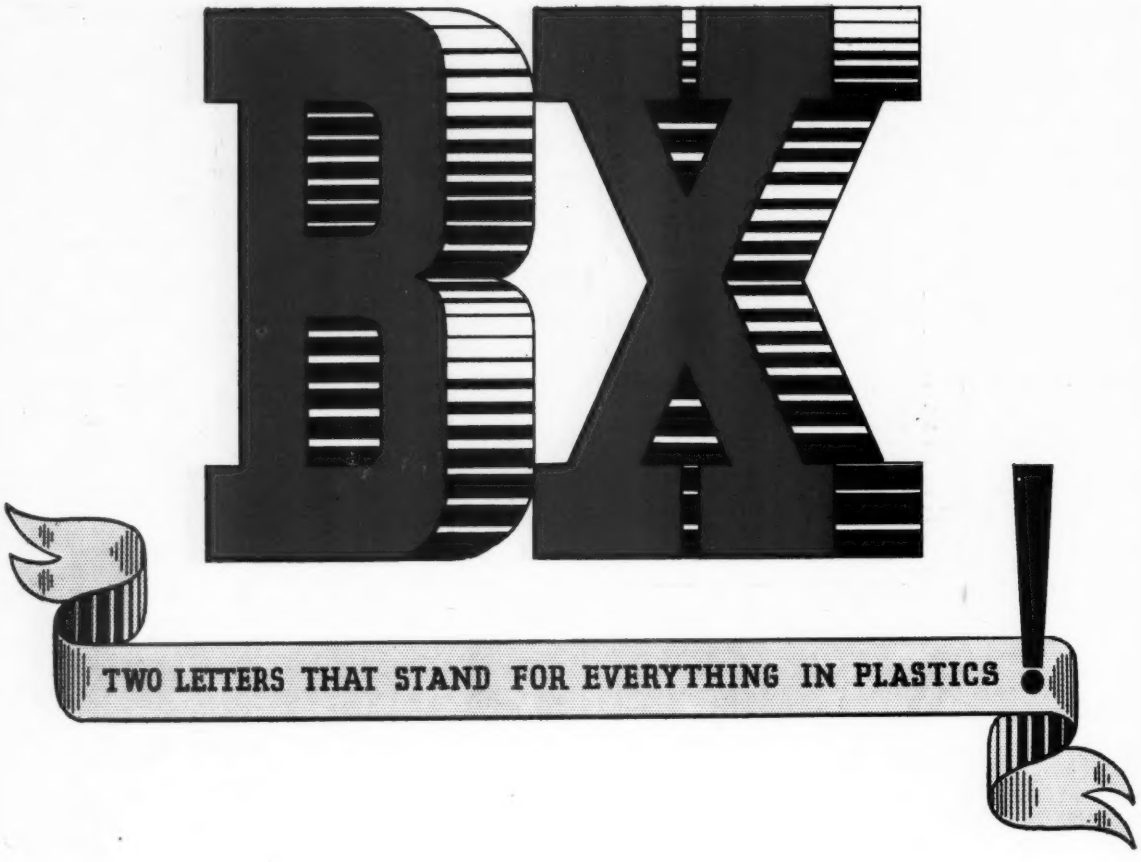
Plastics

DEALING WITH THE MANUFACTURE USES AND POTENTIALITIES OF PLASTIC MATERIALS



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Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Vol. IV AUGUST, 1940 No. 39

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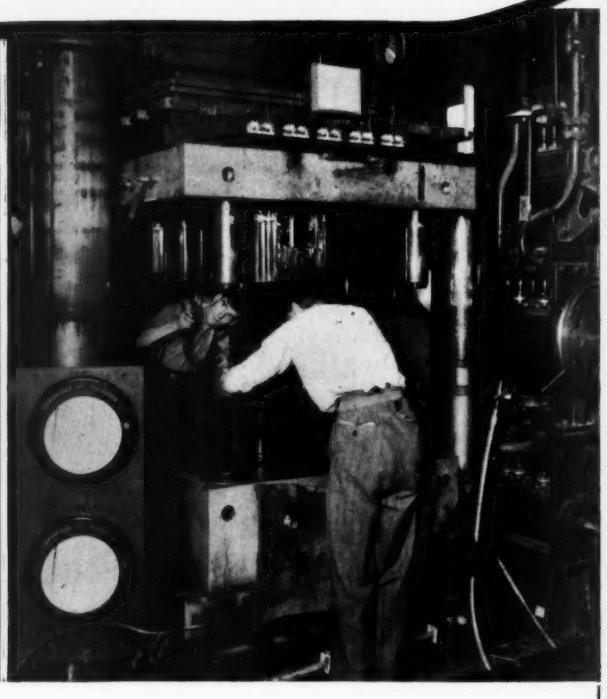

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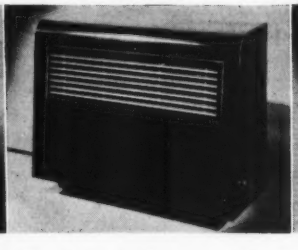
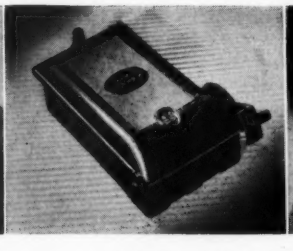
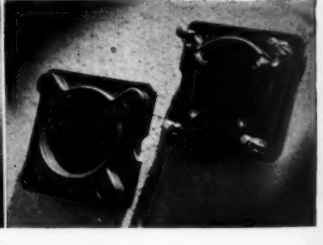






THE MATERIAL OF INFINITE USES

Vol. IV. No. 39 AUGUST, 1940

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Managing Director - ROLAND E. DANGERFIELD

Editor - - M. D. CURWEN, B.Sc., A.I.C.
Offices - Bowling Green Lane, London, E.C.1

CLEAR AND BRAVE NEW WORLD

SILICON and carbon, as every chemist knows, are in the same group of elements in the Mendeleeff table, and these two, in many of their chemical combinations with other elements, resemble one another closely. So far as it concerns our industry, silicon and carbon are the only two elements which can form transparent sheets; silica, in the form of fused quartz, and the various true glasses and carbon as the basis of our transparent plastics, notably cellulose compounds, polystyrene and polyacrylic resins. It was significant that the authors of the paper "Organic Glasses," which we referred to in our December, 1939, issue, discussed the shape and disposition of the molecules of the transparent compounds of both these elements. When the scientist is able better to peer into these molecules and tell us their exact form, why they are able to transmit light and how better we can alter their characteristics, we may produce still more remarkable technical products.

We raise this subject because the real glasses and the organic glasses are, in a sense, fighting for mastery and, obviously enough, each is master so far in its field. The plastic glass cannot, at 4s. or more a lb., hope to do much in normal spheres against window glass at a few pence per lb., and let us be kind enough and admit that the only thing against glass is its fragility and its physically queer and unique characteristic of providing a sharp cutting edge when broken. Conversely, if we can be unkind to ourselves for a moment and be brutally frank, almost the only saving graces of the organic glasses, and we refer only to the sheet forms used to replace real glass and not to transparent mouldings, is their non-splintering qualities, light weight and the ease of producing curved shapes. With one exception, the acrylic type, they lack the transparency of real glass and possess other disadvantages which would soon break a window cleaner's heart. In spite of this, they have cut paths for themselves in fields which silica glasses could not hope to enter.

But what of the future? Some time ago we said that although synthetic rubber was making natural rubber look rather silly, it was quite probable that if rubber chemists worked sufficiently hard they may some day so improve natural rubber as to make the production of the synthetic variety quite unnecessary. If the rich rubber companies had only spent in fundamental research a fraction of the money that has been spent on making synthetic rubber, it is possible that the latter would never have been made.

There is, however, a lot of money being spent on research work on glass, especially by one of the greatest glass manufacturers in the world—the Corning Glass Co. In a recent description of the work of this concern an American journal quotes Amory Houghton, the great-grandson of the Corning founder, as foreseeing houses built of glass bricks and partitioned with glass-bubble slabs which may be sawed and nailed, furnished with glass tables and chairs and draped with glass textiles; equipped with windows which permit light to enter but none to escape. He envisages piping and plumbing fixtures made of glass, automobiles insulated with glass wool on roads paved with glass blocks. He dreams of a malleable glass which can be worked on machine-shop lathes.

Bother this man Houghton! He seems to hope to usurp most of the fields we have reserved for plastics. But although we may smile at these apparently extravagant hopes, wonderful things have already been done with glass in the past 10 years or so by the aid of research. It is well known that Corning has fabricated a shatterproof glass pipe, now widely used in breweries and chemical plant. We have not yet seen a sample of this, but if it lives up to its name, then it may seriously compete with transparent plastics in many fields, including the electrical industry.

All this is merely told to stress the great need of fundamental research in organic glasses and plastics in general. It is unfortunate that such are the present conditions in the industry that, with few exceptions, all scientific energy is devoted to making new plastics instead of devoting some of it to the elucidation of fundamental problems. And it is physical rather than chemical research that is required.

Strange Imports

DOWN the Gray's Inn Road, about five minutes from this office, there are two radio dealers who apparently sell only American sets of what are generally known as the bijou type. We have also seen such shops in the Edgware Road and in Wembley, and no doubt there are thousands of them throughout the country. On general principles we should say that the goods displayed

in the window are sold to British citizens and are not for mere decoration.

What interests us especially is that in one of the Gray's Inn Road shops, of the total units shown, nine possess cabinets made of cast resin or of moulded urea, and in the other there are 16 plastic cabinets. They bear the names of Emerson, Linotone and Weston, and all are about 9 ins. by 6 by 5 in size.

Normally, we do not care to enter into the problems of free trade or taxed imports in the pages of a technical journal, but it does seem strange that, in time of war especially, we should hand over to our American friends good British gold for objects which we can well make in this country of indigenous raw material.

The fault does not lie with the American manufacturers. The small radio set has a large sale in America and they believe there is also a market in this country. Indeed, they have proved there is. The British, or at least English manufacturer, ostrich-like, buries his head in the sand to avoid the sight of the plastic cabinet and, moreover, stuffs his ears with cotton wool. With the result that we, at least, have not yet seen a bijou set made of British cast resin.

It has always been one of our dirges that the use of cast resin could be more widely spread than it is at present. In this country it is almost solely restricted to small fancy goods, handles, etc. Now and again there are brilliant flashes, such as the facia board on the Bentley we mentioned a couple of years ago, or the thousand-odd lavatory seats on a certain great liner we must not speak of; but, on the whole, the use is limited and nobody will take up the applications for radio or for chemical plant. It seems such a pity, more especially now that the manufacture of fancy goods is being drastically curtailed.

Ban on Tin Containers

WE have long advocated the consideration of the curtailment of the use of metal during war for unessential purposes, so that we are pleased with the new order issued last month by Mr. Herbert Morrison, of the Ministry of Supply. From now on the use of tin containers for face powder, shaving soap, cigarettes, sweets, cocoa and many other products will be discontinued. Other commodities, such as soups, fruit, vegetables, condensed milk and tobacco will no longer be sold in small-size tins.

It has been estimated that these new restrictions will save about 50,000 tons of tin plate and sheet metal a year and make them available for war work and exported goods. These prohibitions will, of course, not be general. Some goods, such as cocoa, chocolate, tobacco, will be wrapped in paper or cardboard, but oil, fish and milk will still retain their tins, but the containers will be larger. For example, lubricating oil will be sold in minimum 10-gallon containers.

What will be the effect on the plastics industry? And will it reap any benefit? Unless the steel mould industry is helped by the ready supply of steel, it is unlikely that plastic containers will be possible if new designs are required. On the other hand, there must be in existence a number of steel moulds that have been employed for making containers in the past, and we feel sure that among them would be found some which would be acceptable for use, with little change, especially for the high-class packaging trade. An exhibit such as that held last month by the Plastics Export Group would be helpful to the packaging industry. Were it not for the difficulties of obtaining steel for new moulds, we should have liked to have seen the development of an old idea—the giving or sale at low price, to the public, of presentation plastic caskets by big manufacturers. Into these, comestibles could be emptied from the paper or cardboard container and so stored under better conditions.

Without Comment

Mr. Edgar M. Queeny, president of Monsanto Chemical Co., St. Louis, Missouri, has sent the employees of the 13 American plants of the company the following address.

"As you all know, the national defence programme of the United States is getting under way rapidly, but what you may not yet realize is that in carrying out this programme certain changes in the policies of both government and industry must inevitably be adopted. If the United States is to produce all that is necessary with the greatest speed every American must give both loyalty and complete co-operation.

"I wish to make these points clear: This concerted effort to strengthen our national defences does not mean the United States in any way contemplates entry into World War II. Defence measures are America's insurance against war, the surest means of discouraging molestation by any foreign aggressor. Secondly, our immediate problems concern only the continual normal operation of Monsanto plants and the continued close co-operation of Monsanto employees and management. In this vein, let me stress that now, more than ever before, your loyalty to Monsanto is necessary if we are to carry out whatever tasks are assigned us in this big defence job.

"Many of you will remember that during the first World War, long before the United States entered the conflict, industry was hampered and often harmed by foreign agents engaged in what were then termed 'subversive activities,' now commonly called 'fifth-column tactics.' This probably will be true again. Even now legislation is under consideration by the Federal Government which may require all aliens to register with authorities and be finger-printed for identification. Measures also are being considered which would make both Communists and members of the German-American Bund liable to prison sentences when their affiliation with subversive groups can be proved.

"This gives you some indication of the importance of allegiance to your country and its policies and loyalty to your company in a time when the infiltration of spies and saboteurs into neutral countries is considered a proper war activity. And while all will be vigilant, we must not become 'witch-hunters,' and misconstrue comments of our associates whom we know to be loyal.

"Monsanto is not yet working on defence orders in any important degree—we are entirely engaged in our normal activity of producing chemicals and plastics for normal industrial consumption—but as suppliers to many major industries, such as the steel, automotive, aircraft, rubber, electrical, food, glass, textile, shoe and agricultural, which soon will be producing defence materials—we may be called upon to convert some of our plant facilities to filling Government orders. In this event, it will be necessary to guard against espionage and sabotage, enforce strict regulations concerning new employees and investigate aliens in our organization, as well as establish rigid measures for the policing and protection of our plants.

"I should not like to have my remarks misinterpreted. There are many employees in Monsanto plants and laboratories who are foreign-born. These people have more than proved their loyalty and good intentions, and most of them long have been naturalized as citizens of the United States. It is not to these that I refer.

"In the coming period we must, above all else, co-operate with each other, work toward the common objective and maintain our plants safely and efficiently."

A NEW BILGE PUMP

A Noteworthy Application of Plastic Moulding to Corrosion Problems in Marine Engineering

THE American plastics industry must be very gratified to note the way industrialists are adopting plastics for new purposes and in fields that have hitherto been the prerogative of special metals. There appears, also, to be a tendency leading to much more wholehearted co-operation between the plastics industry and industrialists than exists in this country.

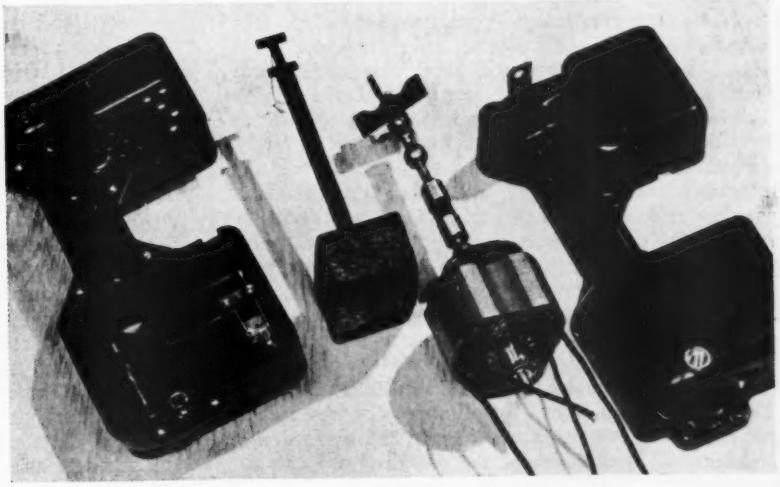
One of the most outstanding of these uses is described in the June issue of *Durez Plastic News*, the well-known house journal of Durez Plastics and Chemicals Inc., of North Tonawanda, N.Y., and relates to the greatest problem confronting the manufacture of marine pumps —corrosion and electrolytic action by sea water. Both attack most metals very seriously, so that their effect on bilge pumps and their components, housings, bearings, shafting and switch parts is of continual concern and loss to manufacturers and marine engineers alike. The George W. Fleming Co., well-known marine pump engineers, who had long experience with metals, tried plastics and found that the phenolic resins possessed most of the advantages for building a pump housing, that is, they resisted corrosion and electrolytic action. Since high water resisting qualities were also necessary, collaboration between the George W. Fleming Co. and Durez Plastics resulted in the suggested use of Durez 75-type moulding compound, which has been specially designed for water resistance. This has proved highly suitable and is, moreover, oil-proof, a property possessed by most phenolics.

Illustrated herewith is the new bilge-pump, built by George W. Fleming Co. with a moulded Durez housing. This, as will be seen, is in two sections and fastened together by six screws. In the lower photograph can be seen the ribs and bosses that are integral in the housing, as well as some of the fastening inserts. The sectional partitions, which serve as assembly guides as well as being functional parts of the operating mechanism, are moulded in also. This is a rather intricate moulding, well designed and, what is so important, has been designed for moulding.

This pump is available in two models, one with and one without automatic switch. There are several outstanding construction features, such as a stainless steel armature shaft for the prevention of the bearing binding by corrosion, monel metal rivets on breaker points of pure tungsten, chamet bronze on other switch parts; sealed cell-type sponge in a hard rubber float; reinforced float rod; spherical-type bearings which are self-aligning and self-lubricating; sway-proof automatic switch, etc.

The moulded housing was produced by the Oris Manufacturing Co. As will be seen from the photograph, it has the appearance of extreme robustness.

The new bilge pump housing of Durez moulded by Oris Mfg. Co., U.S.A.



The two sections of the moulded housing showing ribs and bosses and metal inserts.

The French Plastics and Chemical Industries

Probable Gains to Germany Following the Capitulation of France

AT this time it is of some importance to balance the effect of the fall of France and her industries into the hands of Germany. What, if anything, does Germany gain? It will be interesting to discover whether Herr Hitler will utilize France as a milch-cow for supplying food or armaments or both to his own country.

France is still a predominantly agricultural country, but she is also one of the most scientifically organized in the world. She is not a vast producer of plastics, but is, nevertheless, about fourth on the list and makes up for medium production figures by manufacturing a very wide range of materials.

Before dealing with the purely plastic materials, it will be useful to consider what general raw materials she possesses, for it is these that, in part, give some clue to her plastic manufactures and her value to Germany from the industrial point of view. In the current issue of "The Industrial Chemist" there is some valuable information on this subject.

In raw materials for the heavy industries France is not poor. There is coal in the north, iron in the Lorraine, some lead, pyrites and antimony, and about 2,000,000 tons of potash are produced each year in Alsace. In the south-east there are enormous deposits of bauxite. But, generally speaking, much coal, iron, and most other metals were imported, some from her colonies. Large deposits of phosphate were obtained from her North African colonies.

Hydro-electric Power

After 1918 France, like most other nations, attempted to become, with the aid of her colonies, as self-sufficient as possible and her manufactures of finished chemicals has increased greatly. Among the greatest aids towards this end was the growth of hydro-electric power in the Pyrénées, Savoy and other Eastern *départements*, gradually at first, but with much greater rapidity with the cessation of coal supplies from Great Britain during the coal strike of 1926. To-day, farming and railway transport have been transformed by the introduction of cheap electricity, while electro-chemical industries have sprung up everywhere in the past 15 to 20 years.

In the same period the large coal-mining companies have become important producers of chemicals. Indeed, unlike the mining companies of this country, they have had the foresight to employ enterprising chemists to some effect and have not hesitated to employ chemicals outside their own industries to complement their own or to employ processes other than the mere shovelling of coal from the deep mines. If we can instance just a small example at this point, the Compagnie des Mines d'Aniche, in addition to producing many of the usual chemicals produced from coal, some years ago began the production of "Potazote," a new fertilizer, and more recently of "Carbonalpha," a pure and very finely divided carbon, by the catalysis of carbon monoxide. This finds a wide use as a carbon black, but it has also been employed as a fuel for internal-combustion engines instead of liquid fuels. It is this scientific spirit which has spread almost throughout French industry and which gave to her a promise of future chemical greatness.

Metallurgical and Electro-chemical Works

While the metallurgical industry in France has always been fairly large, the introduction of cheap electricity by hydro-electric installations has been a great fillip to the industry. The great steel and armament factories of Creusot and elsewhere received considerable help from the large plants that were erected for the production of "electric" steels, tool steels, magnet steels, of ferro-silicon, carborundum and the host of other products of electro-metallurgy, and with her great deposits of bauxite France has become one of the largest producers and users of aluminium metal in the world. There, too, magnesium metal and sodium are produced in large quantities. Artificial gems must also be included in the electrically produced commodities.

As for chemicals, a large carbide production, ferrocerium, phosphorus, soda and chlorine, persalts, including perborates, persulphates and peroxides, and many other products have all resulted from cheap electricity by electro-chemical means. And thence have evolved many other industries. For example, the carbide production has resulted in synthetic acetic acid manufacture, in the production of some synthetic "rubbers," and in a section of the plastics industry—the polyvinyl compounds.

We can include in this section the synthetic ammonia industry, which employs so much electricity for heating purposes. While Germany may need no synthetic ammonia as such, the nitric acid produced therefrom may be welcome. Three processes are employed, the Claude, Casale and the N.E.C. (Nitrogen Engineering Corporation). There are six factories working on the Claude process, with a total production of over 200 tons a day; nine employ the Casale process, the biggest being at Toulouse and the total product being over 400 tons a day; two employ the N.E.C. process.

One of the best examples of highly efficient electro-chemical plants is that of La Société d'Electro-Chimie, d'Electro-Metallurgie et des Aciéries Electrique d'Ugine, which possesses several factories in the Grenoble district, drawing on local hydro-electric power. It is one of the largest concerns producing high-speed tool steel and the so-called "electric" steels, metal for magnets and some of the special elements, such as sodium and cerium and special mixtures, such as ferrocerium. About 15-20 years ago carbide and carborundum was first manufactured and this side has rapidly expanded. In addition, many chemicals produced electrolytically are now made, such as sodium potassium and barium chlorates and perchlorates, caustic soda and chlorine and even organic compounds, such as chlorbenzene and other chlorinated hydrocarbons, because of the availability of cheap chlorine.

Another interesting company is the Cie. Asturienne des Mines, with works at Charente and Nord, which produces electrolytic zinc, powdered zinc, electrolytic cadmium and many alloys. This concern depends entirely on imported raw material. As with almost all the French works, the value of these works to Germany must in large part depend on what stocks they had managed to collect before invasion occurred.

Coal Products

As we have already indicated, not only the coke-oven works produce chemicals, but so do many of the coal-mining concerns. These depend largely on imported material, but some of the products and methods of working are of more than passing interest. As an example, one company alone produced nearly 2,000 tons of ethyl alcohol from the ethylene extracted from coke-oven gas and also produced ethylene oxide, ethylene glycol, etc.

We can cite the Cie. des Mines de Béthune as being one of the most progressive under this heading. What has happened to it now must be a matter for conjecture, but if it is in the same condition as the district was during the war of 1914-1918, very little has been left of it. In addition to the usual benzole, toluol, etc., sodium nitrate, methyl alcohol, formaldehyde, isobutyl alcohol and hexamethylene tetramine were also made.

An even broader range of chemicals is made at the well-known coking plant of the Société H.G.D., which produces pure carbolic acid, *meta*-cresol, formaldehyde, hexamethylene tetramine, ethyl benzene, terbutyl-phenol, benzoyl peroxide and, surprisingly, coumarone resins, insulating varnishes, phenol-formaldehyde moulding powders, synthetic copals, and even polyvinyl chloride resins. We doubt if there exists a British tar working plant which can better this splendid effort.

General Chemical Works

We have segregated the following types of chemical works from the above because they are probably more familiar to the general reader. Among them are the largest chemical producers in the country, the most important being the Etablissements Kuhlmann and the Société Rhône-Poulenc, the factories of both of which are probably intact.

The first named is perhaps the nearest approach to our Imperial Chemical Industries, Ltd., in character, although it is much smaller, with a capital of rather more than 300,000,000 francs. The products are extremely varied, ranging from industrial acids of all kinds, including chromic and phosphoric acids, sodium, ammonium, potassium, iron and lead salts, lampblack, glues, coal tar products, glycols, chlorinated hydrocarbons, agricultural chemicals, alkaloids, glucosides, synthetic resins and, of course, a wide range of dyestuffs for which this company is famous. There are 14 separate works of the Etablissements Kuhlmann.

The Société Rhône-Poulenc is in a different category, producing the lighter chemicals and especially medicinal and allied products such as iodine, potassium iodide, potassium permanganate, salicylates, theobromine, piperazine, etc. In the past 10 years this concern has become one of the largest producers of cellulose acetate in the world, and, in addition, makes polyvinyl and polystyrene resins, which are becoming increasingly important to the electrical industries.

The Société Nobel Française is world-famous, especially because of the explosives it produces. This company produces dynamite at two factories, one at Ablon, near Honfleur, and the other at Panlilles (Pyrénées Orientales). Nitro-cotton celluloid and synthetic resins are made at Sauveur (Calvados) and at Stains (Seine).

One may also mention the famous glass producers, Cie. de Saint Gobain, which possess pyrites mines at Sain-Bel (Rhône), phosphate mines at Rebiba (Tunisia) and great "salines" at Art-sur-Meuthe. In addition to glass chemicals, many mineral acids, oxalates, copper salts, silica gel, phosphates, cyanamide, etc., are made.

Wood and Wood Distillation

In the Gironde and Lande districts France possesses part of her greatest wealth. Not only do special woods, such as acacia, for synthetic resin impregnation, grow in abundance, but the pines provide not only pit-props but the raw material for the great turpentine and rosin industries. In addition, her wood distillation industry has always flourished and produces large quantities of methanol, acetic acid, acetone and wood charcoal.

There are no natural deposits of petroleum, with the exception of a small works at Pechelbronn. But there are important refineries working on imported crudes, the most noteworthy among them being at Rouen and at the Etang de Berre, near Marseilles. The first has presumably been destroyed, but stocks in the south and elsewhere are probably large.

The Plastics Industries

Since Germany is second on the list of plastic-producing industries, it may be considered that she will find little use for the plastic manufactures of France. This is by no means altogether true, for we presume she would welcome many additions to her own manufactures, such as cellulose acetate, the "acrylic" and "vinyl" resins and whatever quantity of rubber-like synthetics France may possess.

The casein plastics industry, which is one of the largest in the world, is carried out mainly by the two well-known concerns, Compagnie du Celluloid Petitcollin-Oyonnithe and Etablissements Feuillant Fils at Oyonnax and Ezy (Eure) respectively. Whether this industry will be allowed to exist or be turned over to the production of food cannot be yet known.

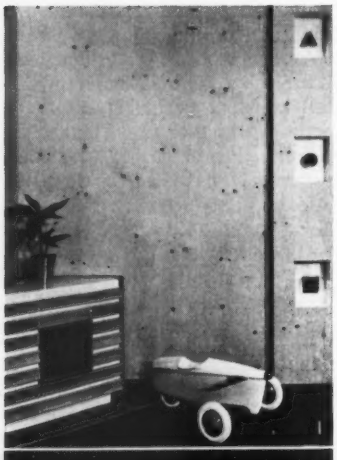
As to the cellulose plastic industry, France has long concentrated on this manufacture. Although produced with imported cotton, there must have been large stocks available before the capitulation, since France was as free to import as Great Britain. Among the largest factories were the Société Nobel Française, which produced celluloid and cellulose acetate in sheet and tube; Etablissements Kuhlmann (raw acetate); Société des Usine Chimiques Rhône-Poulenc (cellulose acetate in sheet, tubes and moulding powders and methyl-cellulose); Compagnie du Celluloid-Petitcollin-Oyonnithe (celluloid and cellulose acetate); Maison G. Convert (celluloid); Société La Cellophane (regenerated cellulose); Kodak-Pathé (photographic film). As indicated in our last issue, large quantities of Rhodoid, the acetate sheet made by Rhône-Poulenc, were imported into this country. It is some consolation to know that considerable stocks of this are in this country and, what is more important, that increased quantities of acetate are being made here.

There are some half-dozen manufacturers of phenol-formaldehyde resins, S.A. La Bakélite, S.A. Ferodo; Société Huiles et Goudrons; M.I.O.M.; R.V.A. (Resines et Vernis Artificiels), etc., while amino-resin manufacture is carried out by Etablissements Kuhlmann, M.I.O.M., Fabriques de Produits de Chimie Organique de Laire, Société Nobel Française, R.V.A., etc.

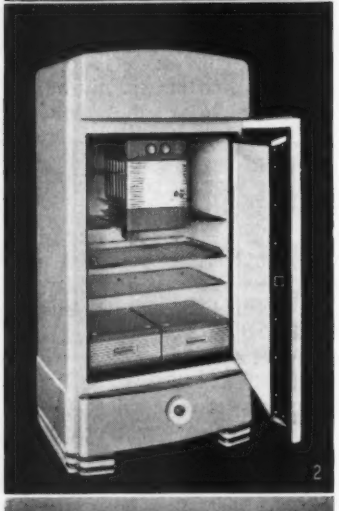
The French industry has long taken advantage of the possibility of synthetic resin manufacture resulting from cheap electricity and carbide production. Hence, the polyvinyl resins have entered industry more rapidly than they have in this country, and five factories produce polyvinyl chloride and polyvinyl acetate or their co-polymers, polyvinyl acetals and polyvinyl alcohol.

As for other polymers, methyl methacrylate, polystyrene and polyisobutylene, are also produced.

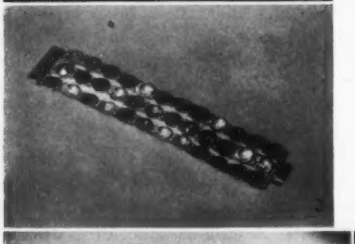
New Mouldings from U.S.A.



1. Cast resin was used for the sphere, cube and cone placed in the niches in the wall. Blue stars of the same material decorate the combination cabinet and bookcase.



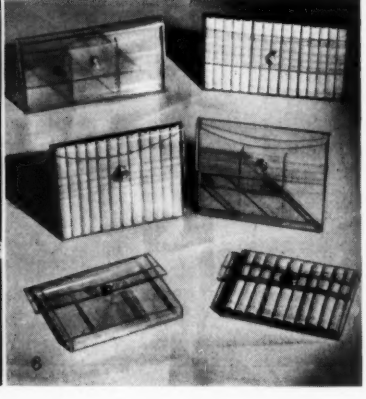
2. Polystyrene, made by Bakelite, Ltd., U.S.A., was chosen for various decorative uses on this refrigerator.



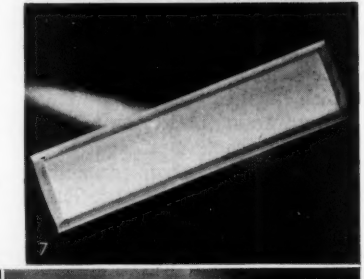
3. Inexpensive jewellery is now made possible by the ingenious use of gem-like cast resin.

4. Plastic frames, moulded in sparkling crystal and cream cellulose acetate, made by Monsanto Chemical Co., feature this new toiletware.

5. These inlaid poker chips are moulded of Bakelite cellulose acetate.



6. These rigid transparent cellulose acetate cigarette cases are being made of Monsanto Vuepak.



7. This luminaire for fluorescent lighting fabricated of Plexiglas was given Honourable Mention in the competition recently held by *Modern Plastics*.

8. Moulded binoculars have the advantage of being light in weight, immune from the corrosive effects of the elements and attractive in appearance.

9. Decorative cast resin containing metal dust was used for this attractive umbrella handle.

BULLET-RESISTING GLASS

Mr. J. H. Fox, Pittsburg Plate Glass Co., U.S.A., describes the progress made in the production of this material in the June Bulletin of the Society of American Military Engineers

THE present war operations have emphasized the necessity of giving the pilots and gunners on fighting and bombing planes as much protection as is possible without interfering with clear vision. This means the use of a transparent bullet-proof, or, at least, bullet-resisting, material.

Glass alone as a protective glazing material for planes, although it can be made very hard, is too brittle to resist gun fire. Transparent synthetic resins or plastics, although tough, are too soft to resist bullet penetration. What has proved to date to be the most effective material for this purpose is known as bullet-resisting glass, which is a combination of glass and plastic. Generally speaking, it is a multiple layer product composed of alternate layers of glass and plastics cemented together. Many combinations and variations are, therefore, possible. As a rule, the thicker the composite the greater the resistance to bullets, although this does not in all cases follow. In practice the following thicknesses of bullet-resisting glass are generally used for protection against various weapons and calibres:—

1⅛ to 1¼ ins. thickness for .45 calibre revolver.

1½ to 1⅝ ins. thickness for .357 calibre magnum revolver.

2⅛ to 2¼ ins. thickness for .306 calibre rifle.

For special uses, when increased weight is not objectionable, the thickness can be increased almost indefinitely, thereby increasing the resistance to projectiles.

For a number of years this material has had considerable use, principally confined, however, to banks, pay booths, police cars and armoured trucks. The use of bullet-proof glass in aeroplanes to date in this country has been excluded largely on account of weight. On account of the high degree of protection given with this material, combined with clear vision and permanence, this objection is now being waived—at least, for certain vital uses. The bullet-resisting glass now on the market was not developed especially for aeroplane use, but, nevertheless, it is doubtless the best material immediately available.

Many factors enter into the design and fabrication of bullet-resisting glass, such as the proper type of glass; most efficient thickness; the arrangement of layers of glass and plastics; the type, composition and thickness of plastic; methods of manufacturing and installing; most desirable shapes and sizes; and resistance at various temperatures. In the case of aeroplane glass, this is further complicated by the apparent desirability of special curved forms; the lack of rigidity of the supporting plane structure; and the desirability, in certain locations at least, of a high degree of perfection in optical qualities. It is evident from the above that the final product is, to a large extent, dependent upon the relative emphasis placed upon the various desired qualities.

Under the present emergency conditions and necessity of quick action, what is needed is, first, immediate and intensive development work on how to adapt the present product to aeroplane conditions, and, second, paralleling the above work, to make every effort to develop the best product possible for aeroplane use, going the limit in research and development work. The second proposition will necessarily take more time than the first. Similar development work should be done on bullet-resisting glass for tanks and other fighting equipment, although it appears that the limitations with reference to weight and other factors are not as great as in aeroplanes.

The above statements emphasize the great need for active and direct co-operation between the Government aeroplane designers and manufacturers of planes and glass to get prompt action and avoid needless waste.

The Storage of Plastic Packaging Materials

This brief but factual survey appeared in the June issue of "Modern Packaging"

"CELLOPHANE" sheeting materials are supplied by their manufacturers with a predetermined moisture content. They are capable of absorbing moisture. They are capable of drying out. Therefore they should not be stored or handled under extreme conditions of heat, cold, moisture or dryness. The optimum temperature for storage is 70 degrees F. A 50 per cent. relative humidity is most desirable.

Purchasers of converted sheets, bags and other forms of "Cellophane" have, on occasion, experienced difficulties with shipments received during or immediately after extreme cold spells. Such shipments, having been subjected to transit during subfreezing weather, should be allowed at least 24 to 48 hours to reach room temperature before being used.

Unconverted sheet or roll stock is usually securely packed to be in prime condition for the maximum length of time. Original packages should not be opened until ready for use. When entire packages or rolls are not to be consumed immediately after opening, the unused portion of the packages should be rewrapped in their original wrappers for over-night or longer storage.

Rolls should be stored in their original shipping containers until ready for use. Most manufacturers recommend hanging the rolls horizontally. Sheets should be stacked, but such stacks should never be too high. One manufacturer recommends 10 packages of 1,000 sheets each as maximum stack height, and advises smaller stacks in humid weather. Adherence to this specification will prevent sheets from sticking.

The moisture-proof types of "Cellophane" are not as readily affected by climatic changes as are non-moisture-proof varieties. Nevertheless, the precautions described above apply to moisture-proof varieties, though, perhaps, to a lesser degree. One supplier recommends against the purchase and storage of more than a 60-day supply of material, as fresh stock can be obtained promptly.

Acetate Sheetings

Acetate sheetings, supplied in rolls, should be stored hung horizontally in suitable wraps at a room temperature of 70 degrees F. and 50 per cent. relative humidity, out of direct sunlight. The temperature should in no instance exceed 90 degrees and 55 per cent. relative humidity. Low temperature and humidity have no serious deleterious effect, but rolls may require conditioning before fabricating if stored at temperatures at the freezing point or below.

Sheets should be stored in their original wraps and laid flat on smooth shelves under atmospheric conditions similar to those described for rolls above. They should not be stacked in piles more than 12 ins. high.

Rubber Derivative Sheetings

These materials are virtually unaffected by dryness or dampness, and hence special temperatures or humidity precautions are not generally considered necessary. Conditions in the average packaging plant are within the wide range which is not detrimental to such rubber derivative materials.

Materials are, however, affected by strong sunlight, and should be shielded from the ultra-violet rays of the sun either by storing in the dark or wrapping the rolls or bundles in opaque paper. Rolls should be stored on end, with the ends reversed every two or three months so that there is no tendency to inflex one end. No particular precautions as to circulation of air are required.

Ethyl Cellulose Sheetings

Moisture absorption of these materials is low, and volume change under storage conditions is, therefore, very small. The plasticizers of these materials are not moisture-soluble or volatile and do not bleed.

The foils usually employed for the manufacture of rigid fabricated or drawn shapes have a very high softening point, and can, therefore, be subjected to temperatures—in storage—up to approximately 145 to 150 degrees F. Precaution should be taken to avoid extreme changes in temperature during processing such as multi-colour printing, although the coefficient of thermal expansion is not excessive.

Foil which has been subjected to extremely dry conditions will, if brought into contact with humid air, expand about ¼ of 1 per cent. (0.0025 in. per in.), but this expansion is not experienced under normal changes.

The above brief notes should prove of considerable practical assistance to the packaging departments of toilet goods and pharmaceutical manufacturers who now use considerable quantities of cellulose and rubber derivative sheetings.

BUILDING THE TIMM TRAINER

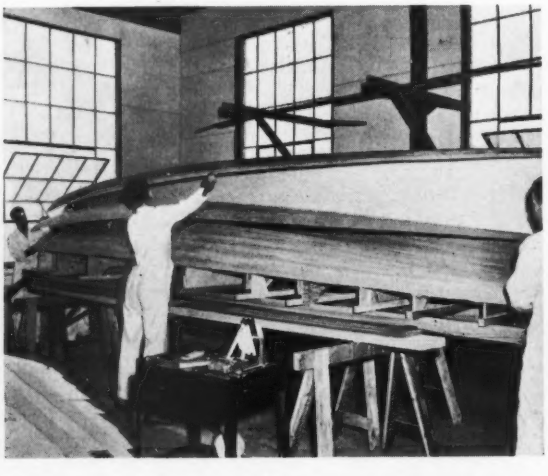
A GOOD deal of publicity has been given to the construction of the Timm trainer, and much interest has been aroused throughout the world. The two photographs shown below illustrate two of the most important stages in the production of the aeroplane. Advantages claimed for the Timm trainer may be briefly summarized as follow:—

(1) Great reduction in weight. This amounts to 20 per cent. less than that of the same size in all-metal stressed-skin type of construction.

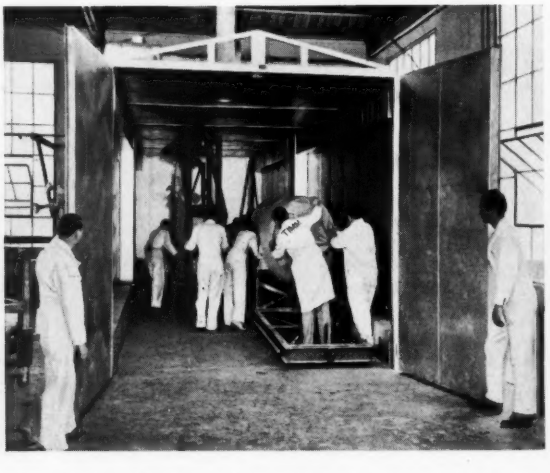
(2) Streamlined design, which improves efficiency and performance of the aeroplane. There are no rivet heads or holes on the surface of the fuselage and wings of the Timm trainer, and the craft offers the minimum resistance to the air during flight.

(3) Ease and rapidity of manufacture, which are especially valuable in war-time.

(4) Reduced cost of manufacture.



This picture shows halves of fuselages being formed into a single unit which is later baked in an oven at 250 deg. F. The structural weight of the finished plane is about 20 per cent. less than that of the same size of metal construction.



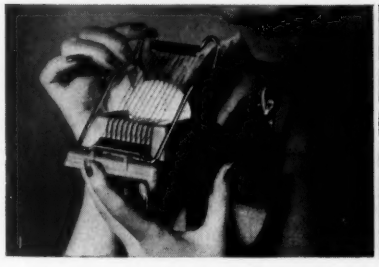
This photograph shows the complete fuselage of the Timm Trainer being wheeled into an oven where controlled heat (250 deg. F.) and humidity fuse the plywood veneer, plastic binder and surface coating into a rigid whole.

Embossed Cellulose Acetate for Fluorescent Lighting

Monsanto embossed cellulose acetate, for use in fluorescent lighting fixtures, is so light and flexible that even a woman can handle a large sheet without difficulty. The surface texture, carefully designed to provide maximum light transmission with full diffusion, is embossed on the sheet.

NEW DOMESTIC APPLICATIONS

These mouldings show some of the latest applications of plastics in the home. The designs are simple and yet calculated to combine utility of purpose with smart appearance. Reasons for the popularity of domestic accessories moulded of plastics are not difficult to determine and are mainly due to the clean, hygienic and non-staining surface of the material, bright colours that do not bleed and cannot be worn away, and simple and yet pleasing streamlined designs made possible by moulding technique. Although the examples shown in the accompanying three photographs are of American origin, they clearly illustrate the trend of design in this particular field, and open up interesting prospects for post-war developments.



(1) The hardest-boiled egg in the world could not resist this colourful and non-corrosive egg slicer moulded of Monsanto Resinox plastic.

(2) This attractive bowl is moulded of polystyrene resin and represents an entirely new use for plastics. The feather-weight bowl is of generous dimensions.

(3) Monsanto phenolic resin, Resinox, was used for this corer and slicer. It is a useful gadget and is reputed to sell well in the U.S.A.

C

WORLD'S INDUSTRY

AGRICULTURE

Ligno - cellulosic waste materials, generally classed as farm-waste matters, can be used as a basis for making new and interesting plastics. A report just issued by the U.S. Forest Products Laboratory is, therefore, of particular interest. Following acquisition of proper equipment for continuing these studies, a few preliminary digestions with aniline were made, which indicated, at least for bagasse, that this method of making plastic materials offered much greater opportunities than the acid-hydrolysis method for producing commercially usable products. Strength and flow properties apparently could be varied over wide ranges. The object of this study was to show which of the several factors entering into the production of these plastics was of most importance and, if possible, to find conditions which would result in a moulding compound suitable for commercial use. It is self-evident that it would be an impracticable undertaking to attempt to establish positively the best possible combination of the seven or eight major factors in the preparation of these plastic compounds; it was hoped that the possible combinations could be narrowed to within reasonable working limits. In order to make the most efficient use of the equipment involved, it was necessary to follow a definite schedule of work carrying out this study. Because of this, certain arbitrary procedures followed were later found to give rather unsatisfactory results. The raw material or bagasse used in these experiments was from the 1938 crop of Louisiana sugar cane. Prior to use, several bales of the bagasse were broken up by passage through a very coarse shredder. The shredded material was thoroughly mixed and air-dried to approximately 7 per cent. moisture. Moisture analyses were made daily and all figures reported are based on oven-dry bagasse. Digestions were made in a steam-jacketed, tumbling, bronze autoclave having a capacity of 20 gallons and rotating at approximately four revolutions per minute. Fifteen pounds of bagasse were used for each digestion, with the exception of run 25 in which only 10 lb. could be used with the desired water-to-bagasse ratio. Each of the four principal digestion factors, (a) ratio of aniline to bagasse, (b) ratio of water to bagasse, (c) pressure, and (d) time of digestion, were varied individually while holding the other three factors constant at arbitrarily chosen values. The ratio of aniline to bagasse was varied from 0 to 0.35, the digestion pressure was varied from 90 to 190 lb. (the upper pressure limit of the digester) by 20-lb. increments, and time at pressure was varied from 30 to 300 minutes. Study of the effect of the water-to-bagasse ratio was limited to three digestions, using weight ratios of 3.75:1, 5.60:1, and 7.46:1, respectively. Only one digestion was made at each condition, since the additional work involved in duplication was not considered necessary in a preliminary study of this nature. To make a digestion, the bagasse and the chosen amounts of water and aniline were sealed in the digester, steam turned into the jacket, and rotation started. The contents of the digester were brought up to the desired pressure as quickly as possible, venting the enclosed air and non-condensible gases until the internal temperature corresponded to the selected pressure. The time required to reach this pressure was recorded and the digestion continued for the predetermined period. At the end of the digestion, the digester was blown down as rapidly as possible without loss of fine material. The contents were dumped and filtered on a stoneware vacuum filter, washed thoroughly with hot water (using a total of 25 gallons of water in five or six washes), and dried at 220 degrees F. The dried material was ground and plasticized. Moulding conditions were chosen arbitrarily. Since these powders are slow-curing under the conditions used, they are essentially thermo-plastic and, therefore, moulding conditions are relatively unimportant, except that temperature and pressure must be high enough to obtain complete flow. Flexural and impact test pieces were moulded in a single-cavity hand mould which produced bars ½ in. by ½ in. by 5 ins. long. The mould was constructed with interchangeable bottom force plates to make both straight bars for flexural and unnotched impact test pieces and a notched impact test piece with a notch of dimensions as specified by A.S.T.M. Committee D-92. The mould was loaded at approximately 200 degrees F., placed in the press, and the required pressure applied and held until the temperature reached 320 degrees F. This temperature was maintained for seven minutes, following which the mould was cooled, under pressure, to 200 degrees F., and the piece ejected. Moulding pressure was 3,500 lb. per sq. in. Complete moulding cycle was about 35 minutes. Moisture-resistance test pieces were made in a 3-in. diameter disc mould, following the same procedure as with the flexural and impact test pieces. This moulding cycle was 22 minutes. The ash trays used for the drop test and as a criterion for moulding quality were moulded in a single-cavity, positive hand mould. This mould was preheated to 320 degrees F., loaded with moulding powder, and pressed at 3,500 lb. per sq. in. for four minutes. The mould was cooled to 200 degrees F. before opening. Flow was judged as unsatisfactory (incomplete), fair (just complete), and good (complete with considerable flash).

ELECTRICAL

Thermostatic control elements are now being made by dissolving a vinyl chloride resin or synthetic rubber (chloroprene) in a melt of diphenyl dibromobenzene or dichlorobenzene and dispersing in the melt solution a powdered substance which conducts heat well, e.g., graphite antimony, aluminium or copper powder, the melting point of the solvent being chosen to fall within the range in which the thermostat is to operate. The process is covered by British patent No. 507,501. **Cellulose acetate** possessing an exceptionally high electrical resistance is made by acetylating cellulose with the aid of an acid catalyst other than sulphuric or phosphoric acid, washing the product with electrolyte-free water and compounding it with electrolyte-free plasticizers. **Cable insulation** using polystyrene resin described in British patent 508,036. Barrier joints in impregnated power cables are insulated with fabric which is impregnated with a polystyrene resin. The resin may be plasticized with rubber, polyisobutylene or the like.

MOTORS

Applications of phenolic resins in the motor industry are diverse, but the most general are in parts of the electrical system where a good dielectric is required, as in distributor heads, coil parts, switches and related elements.

RYEMPLOYS PLASTICS

These accurately dimensioned interchangeable moulded parts of the ignition system, which remain undistorted under the heat of the adjacent engine, have played an important part in contributing to the trouble-free service characteristic of the modern car. Chief among the purely mechanical applications of phenol resinoids in the motor-car is that of the camshaft gear of canvas laminated resinoid, used to silence the operation of the timing train. An increasing amount of phenolic resins is entering into the composition of materials for impregnating brake linings, with the advantages that accrue from substituting infusible resins for fusible materials. The automotive industry also makes use of phenolic-resin-bonded grinding wheels, which, because of their higher working capacity, greatly lessen labour and power costs in operation. Some of the early applications of plastics in aircraft were simply carry-overs from car designs, while others have grown out of striving to solve new problems. Distributor heads, magnetos, conductor terminals, switches, instrument housings and terminal sleeves are among aircraft parts being made with the use of phenolic materials. In aeroplane radio sets, panels, tube sockets, condensers, mountings, coils, binding posts, knobs and dials are being made of phenolic plastics. Laminated canvas-phenolic materials are used for cable pulleys and bushings. Abstracted from article on "History of Plastics and Their Uses in the Automotive Industry," by Dr. Gordon M. Kline, *Modern Plastics*, July, 1940.

CHEMICAL

Butyl synthetic rubber plant in New Jersey could meet the major rubber needs of the United States, according to an announcement made at the recent annual meeting by Mr. W. S. Farish, president of the company. Should it become necessary for the United States to produce synthetic rubber in substitution for a major proportion of imported natural rubber (he said), we are in a position to manufacture the butyl rubber from petroleum in any required quantities as rapidly as the necessary plant facilities can be installed. The new rubber, which is called butyl, was described as a companion to buna rubber, a synthetic product originated by I.G. Farbenindustrie, A.G., of Germany. A plant to make 10,000 lb. a day of the buna product is under construction at the refinery of the Standard Oil Co. of Louisiana, a subsidiary, at Baton Rouge, La. The plant is expected to be completed this year. Mr. Farish explained that buna was originated by the Germans and originally produced from limestone and coal, the cheap raw materials of Germany, but that in the company's buna plant at Baton Rouge it would be produced from oil. The butyl rubber is made from petroleum by processes more direct and simple than those required for the production of buna, he said. It is more nearly a straight petroleum product and although its manufacture involves the most advanced technology, they had solved successfully the primary production problem and already have in operation a semi-commercial pilot plant at the laboratory in Bayway, N.J. The butyl rubber is not an oil-resistant product and therefore will not be in direct competition with buna for the speciality markets. The butyl rubber has, however, special properties of its own which make it superior to natural rubber for many uses. The commercial development of butyl rubber will be in stages, the first being the manufacture of relatively small quantities for the speciality market and for commercial testing in tyre production. Mr. Farish also disclosed that Standard of New Jersey owns the patents for the production of buna and butyl rubber for the United States and the British and French Empires. Originally, he said, chemical developments of Standard Oil were carried on by a company owned jointly with the I.G. Farbenindustrie, A.G., but that last summer, to avoid difficulties, the New Jersey company acquired all the stock of Farbenindustrie. No cash payment was made, he explained, the Farbenindustrie receiving the patent rights for the rest of the world outside the United States, Britain and France.

MISCELLANEOUS

Rubber - like material from wax is claimed to have promising industrial possibilities. The feature of the new material is said to be the simplicity of its manufacture, which contrasts with the costly processing called for by other rubber-like materials. The wax is put into a special container where it is maintained at a temperature of approximately 400 degrees F. A constant stream of air is circulated through the liquid wax, while peroxide of hydrogen is added to the mix. After a few hours of such treatment the wax turns into a rubber-like material, which is not only elastic, but offers decided resistance to oils and greases and other substances generally injurious to crude rubber. Experiments with the process are said to have resulted in a material with definite commercial possibilities, although little is known of the material or the process other than the data above. **Latex for road expansion joints** described in a recent article, entitled "Advances in Latex Technology," in *The Rubber Age*, N.Y., U.S.A., June, 1940. Experimentation with latex compositions for road expansion joints has been carried on for a number of years, but it is only recently that really satisfactory materials have been developed. Because of the expansion and contraction of concrete slabs used in road construction with heat and cold, and in wet and dry weather, it is necessary to use some material in the joints to maintain a smooth surface. Asphaltic cements originally used for this purpose have proved quite unsatisfactory because of their tendency to creep out of the joint in wet weather and to become brittle and break in cold weather. Several types of joint composition have been developed, some of which have been found very effective in eliminating both discomfort to drivers and the destruction of the road itself. The specifications involved as a result of this work call for a material which shall consist of "a liquid rubber compound (used with or without a primer) which will easily pour into an open concrete joint." The material must also set sufficiently in one hour to prevent infiltration of water or other materials and must solidify within 24 hours, adhering firmly to the concrete. It must not show disintegration through wearing. One method said to be completely satisfactory, comprises inserting a premoulded strip in the joint and over this is applied a pasty latex composition containing cork or other filler. While the initial cost of latex joints of this type is considerably higher than those of asphalt, the maintenance cost is much less, and considering the savings on road maintenance the final cost of the latex compositions represents considerable savings. In another type of joint found particularly effective between bridge piers and retaining walls, strips of sponge rubber having a thickness of $\frac{3}{4}$ in. to 1 in. are inserted in the road joints.

OPPORTUNITIES FOR PLASTICS IN THE FOOD INDUSTRY

By Hadyn K. Wood

THE growing interest now being shown by food manufacturers in the use of plastics for modern processing plants is clear evidence that the food industry offers many potential applications to the plastics industry and is, therefore, well worth surveying in order to determine in what manner and under what conditions its materials could be utilized.

It has to be remembered that the main requirements of the food industry are as follow:—

1. Materials of good mechanical strength which lend themselves very readily to the fabrications of various types of plant. These materials must be tasteless, odourless and unaffected by immersion in weak acids and other chemicals likely to be employed in food processing. They must also be immune to the corrosive effects of the atmosphere in the factory. The importance of this latter requirement is frequently overlooked and yet it is known that even nickel, nickel alloys and stainless chromium steels are all liable to attack, especially if exposed to unfiltered air containing particles of solid matter which, in the neighbourhood of manufacturing towns or near the coast, may consist of chemically active ingredients. These solid particles accelerate the corrosive action of traces of sulphur in the atmosphere.

2. The materials must present clean and unbroken surfaces, as the development of cracks, pit marks and other surface irregularities may lead to serious contamination of foodstuffs by bacteria, fungi, and harmful impurities left untouched by any cleansing process.

3. The materials must not be affected by ordinary cleansing or, if necessary, sterilizing agents. This is important as it rules out those materials which are readily susceptible to hot water, steam and antiseptic bodies.

Bearing in mind the above general requirements, it is now opportune to consider quite briefly how far plastics come up to expectations. Dealing with No. 1, it is apparent to anyone with only the most rudimentary knowledge of plastics that the range of materials now available is so extensive that practically all reasonable requirements as regards strength can be assured. Fabrication is, in most cases, simple and, in addition, the weight of the moulded or built-up plant is considerably lighter than metal, although heavier than wood. This is important because it means that small pieces of plant can be handled with less labour than would be the case if they were made of metal and that large structures may be fixed in positions unsuitable for heavy metal plant unless floors were strengthened. As regards the ability of plastics to resist corrosion, it is reassuring to know that all those recommended for use in the food industry are immune to the effect of weak mineral or organic acids and many other corrosive chemicals used or liable to be used in food processing. Alkalis are not normally met with in the food factory to any important extent, so that those plastics which are sensitive to alkalis may be used with every degree of safety. Atmospheric corrosion need never trouble users of plastic or plastic-coated plant, as even under the most trying conditions the surface is quite unaffected by the agencies liable to corrode metal.

An important advantage shared by all plastics is the ability to conserve heat by reason of their excellent heat insulating properties. This makes for valuable heat economy and also ensures that there is no inconvenience to workers who approach moulded plant containing hot liquids, pastes, etc.

Dealing now with requirements 2 and 3, it is satisfactory to note that moulded and fabricated plastic surfaces are smooth and jointless, although, of course, large areas are necessarily built up of separate units bolted or otherwise joined together. Such surfaces are particularly easy to keep clean and there is thus no risk of food becoming contaminated by spores of bacteria or fungi lurking in cracks or crevices. It is possible to keep a smooth moulded surface in spotless condition with far less trouble and labour than either wood or metal. The latter has to be very carefully looked after to prevent the formation of films on the polished surface of the metal. These films are generally due to several causes, such as the presence in the air of traces of sulphur dioxide or hydrogen sulphide, solid particles and a certain optimum degree of humidity. Incidentally, humidity itself is sometimes very troublesome and when moisture condenses on cold metal surfaces it is liable to fall on pans or other vessels containing food. Condensation from metal surfaces is known to be a source of contamination and is particularly dangerous in gelatine factories. Gelatine and similar proteins are very susceptible to attack by bacteria and fungi as they offer the finest medium for cultivation. Plastic surfaces are free from this danger and very little condensation takes place under conditions liable to be met with in food processing plants.

A powerful argument in favour of moulded or extruded plastic plant is that, owing to the great needs of our war machine, metals of all kinds, particularly the non-ferrous ones, have to be conserved for Government work. The alternative is plastics, as even wood, which can normally be used for building tanks and certain other simply designed pieces of plant, has to be imported from Canada and must, therefore, be greatly restricted in use.

Choice of Plastics for Food Processing Plant

Dealing first with the storage of foodstuffs, a topical problem in war-time, it is apparent to all that plastics might well be employed for this purpose. The storage of animal and vegetable oils and fats for hydrogenation and subsequent conversion into solid oils and fats can be very successfully carried out in large plastic containers or metal tanks lined with a non-corrosive and tough plastic film. Large cylindrical tanks, moulded in one piece, seamless and jointless and measuring in diameter up to 9-ft. and 10-ft. deep, or deeper units constructed in sections and bolted together by means of suitable flanges, are to-day being made of Keebush.

All these vessels can be provided with flat, dished or cone bottoms and covers. In addition, Keebush rectangular tanks are manufactured in lengths up to about 10 ft. in one piece without seams or joints and tanks up to 60 ft. have been built up in sections and connected by flanges and bolts. There is a distinct advantage in storing bulk oleaginous material in non-metallic containers as they are not liable to be contaminated in any way with even traces of metallic impurities, some of which are known to accelerate rancidity changes by acting as a catalyst in promoting oxidation. Metallic impurities are also undesirable, as they may reduce the activity of the nickel catalyst used in the hydrogenation process.

All types of tanks moulded or built up of Keebush are very strong, as the material itself possesses a bending strength of about 470 kg./cm.^{2}, compressive strength 700 kg./cm.^{2}, and tensile strength of 1,050 kg./cm.^{2}; impact strength of 25 kg./cm.^{2}. In addition, the vessels and pieces of plant may be safely used up to 265 degrees F. and are unaffected by rapid temperature changes. A very important use for Keebush is in the construction of crystallization vats used in the manufacture of lemonade crystals and different kinds of pharmaceutical products and industrial chemicals. Owing to the smooth jointless surface of the material, crystals can be very easily removed and, in addition, the vessels flushed out with the minimum of trouble. Crystallizing pans, drying trays, agitators, filter press plates and frames are all now being built up of Keebush and extensively employed in the food industry.

Apart from the use of inert plastic containers, such as Keebush, it is worth while remembering that metal tanks can be rendered non-corrosive by coating with certain synthetic resins, such as Lithcote, which is a non-vitreous baking enamel consisting essentially of a phenol-formaldehyde or Bakelite resin. The actual process of applying Lithcote is a patented one and results in the formation of a film 3/1,000-in. thick, which adds only 1/20th of an ounce per sq. ft. of treated metal. The coating of polymerized resin is perfectly inert and stands up very well to abrasion and wear. It is also absolutely odourless and tasteless and Lithcote protected plant is now being widely used for food processing plant handling sauces, catsup, jams, dairy produce, as well as vegetables and fruits for canning.

There is no lack of evidence that if direct contact between metal and foodstuffs can be avoided by the use of a non-metallic coating or film, then the risk of serious deterioration may be greatly diminished. In particular, where the acidity of a food has to be maintained within close limits, the use of an organic material container greatly facilitates matters for the works chemist and manager. Lithcote treated plant is also particularly useful for preparing mayonnaise-type emulsions where the vinegar is known to have a marked corrosive effect on metal parts.

Turning now to the storage of dry foodstuffs, plastics again offer striking opportunities, as it is known that direct contact of some foods, particularly flour, with the tin promotes rancidity. One of the most suitable containers for flour and cereals generally is one made of an inert and water resistant rubber hydrochloride, such as "Pliofilm." This material can be used to line an ordinary jute or canvas sack. The actual "Pliofilm" container can be sealed under vacuum when full and thus made to keep the flour, etc., absolutely free from moisture, dust, etc. Such material as "Pliofilm" could also be very advantageously employed for lining cardboard and even wooden containers and so ensuring the preservation of many different types of food which are known to be adversely affected by contact with metal. Metal can be corroded and its salts promote rancidity.

Lucite for Footwear

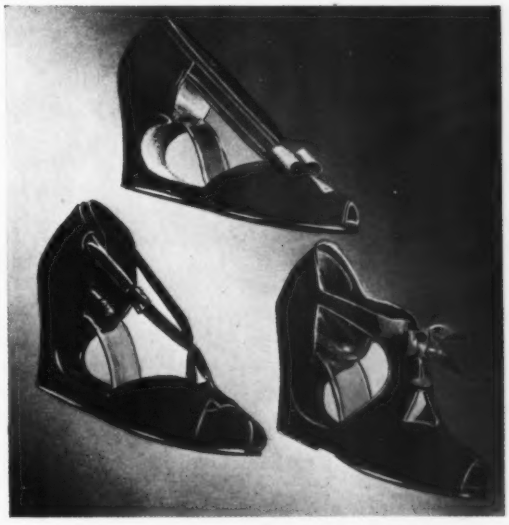
A WELL-KNOWN American shoe factor is now showing a new shoe made with an arch-supporting shank of transparent Lucite, the well-known Du Pont acrylic resin. The material is unnoticeable on the foot, and the shoe has the appearance of a shankless model without losing the supporting qualities of the conventional construction.

At present, the shoe is shown in three suède models, each with a 2⅛-in. scooped wedge heel and modified open toe. Patterns include a semi-Oxford type with Crossgrain ribbon tie, a pump with snakeskin trim, and a cross-strap model fastened by a side buckle.

The shoes with the " invisible " shanks are shown in the accompanying illustration, in which the strong and durable " bridge " of transparent Lucite, which enhances the appearance of the styles shown in picture, " disappears " when the wearer steps into the shoe and accustoms herself to its style and somewhat unusual design.

Acrylic resin is very suitable for this novel application, as, apart from appearances, it is resistant to sweat acids and has an exceedingly low moisture absorption figure. From the comfort angle, it is of interest to stress the fact that this plastic material is never really cold to the touch in the same way as metal. It is also completely non-staining and can be guaranteed not to stain even the finest silk stockings.

Lucite and Plexiglas are being used for footwear ornaments, such as buckles, and they have attracted a good deal of attention on account of their unusual appearance as illustrated by edge lighting effects. Apart from the glass-clear resin, use is also being made of fluorescent tinted material which glows mysteriously in bright light.



Examples of Lucite arch-supporters as used in new American shoes.

Celluloid Protects Oil Pipe Lines

Pipe lines in sour soil need to be protected against corrosion. The article below describes successful methods made possible by the use of sheet celluloid for wrapping round the metal pipes

EXPERIMENTS have been conducted in the Texas oil fields for more than six years by a major pipe-line company in an effort to find a protective coating material that would be physically and economically satisfactory for use on oil lines. From the many materials tested, there has emerged one shield of considerable promise—celluloid sheeting.

The first tests were made at Spindle Top Gully in the Texas oil fields in February, 1934. Rolls of transparent "Pyralin" (cellulose nitrate manufactured by Du Pont de Nemours) .005-inch thick were applied in two spiral wraps which were bonded to the pipe with an adhesive. This location was selected because the soil conditions there were not only highly corrosive but also because the coating would be subjected to extreme stresses from the expansion and contraction of the earth due to temperature changes. After three years underground, the pipes were unearthed. Examination proved so encouraging that further tests were ordered made on two sections of an operating line.

Protecting an experimental lap joint. One man wraps the pipe with celluloid whilst the other applies the sealing compound.

In one case clear, transparent cellulose nitrate .005-inch thick was used, and in the other black nitrate .008-inch thick. A coat of hot asphalt was applied to a six-inch diameter pipe which was then wrapped with the celluloid shield. The line was replaced in soil known to be highly corrosive and inspected intermittently over a period of three years.

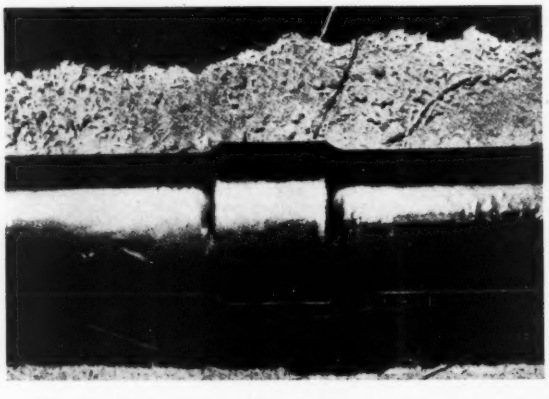
Final inspection of the two sections showed that both the clear and the black celluloid had remained free from chemical or physical change. Considering that a price differential favoured the black material, it was decided to select that colour for future work, and to use .010-inch thick material as a safeguard against breakage from clods and rocks in the trench bottom.

Having selected a material meeting all the requirements for protection, experiments were next made to determine the best type of undercoating to be used and the best method of wrapping and joining the celluloid shield. Numerous undercoatings were tried. At the same time, experiments were made with butt-weld joints sealed with a narrow strip of celluloid, lap welds sealed with paint and with pyroxylin cement, and unsealed lap joints. The unsealed lap joint over a grease coating proved most satisfactory.

There are several reasons for the successful use of cellulose nitrate for pipe-line covering. It is not appreciably affected when exposed to damp atmospheres or immersed in water. Under normal conditions it will absorb only about three per cent. of its weight. In addition, it is only slightly affected by weak acids and weak alkalis. Experiments show that it remains smooth and hard when underground; that when earth surrounding the pipe contracts due to change in temperature, it slips away, leaving the wrapping unharmed. The material has the required rigidity and yet is pliable enough to permit easy application.

Black "Pyralin" celluloid used for pipe-covering work has a specific gravity of approximately 1.4. The .010-inch thick material weighs about .072 lb. per sq. ft. and has a tensile strength of about 8,000 lb. per sq. in. This plastic withstands temperatures as low as 20 degrees F. before becoming brittle, and up to 160 degrees F. before softening begins. Its flash point is 525 degrees F.

To obtain a tight fit around obstacles such as collars, girth welds, edges of half soles and over pit welds, the sheets are first softened in a liquid solution of one part ethyl acetate, three parts alcohol and four parts water. The celluloid expands, when softened, but upon drying shrinks a greater amount, making possible a tight form fit. If the softening solution contains too much ethyl acetate or alcohol, it will cause disintegration, a condition that should be guarded against. This is apparent, too, when softening progresses unevenly. Best results are obtained when the cellulose nitrate softens uniformly in about 30 minutes so that it may be easily formed without tearing. A convenient softening agent, manufactured by the Du Pont Co.'s Organic Chemicals Department and sold under the trade mark "Ketanol," is well recommended.



After more than two years' exposure in corrosive soil this celluloid shield over a pipe collar is still in good condition. Du Pont "Pyralin" brand of celluloid was used for all this experimental work.

Nylon and Similar Protein Plastics

THE widespread publicity given in this country to nylon, the news that it is to be made here by I.C.I., Ltd., and Courtaulds, Ltd., and, further, that Halex, Ltd., and Addis, Ltd., are already selling toothbrushes made with nylon, has aroused much speculation of the future of many industries. In truth, some of them are changing before our eyes economically, technically and geographically.

To elaborate this, then, we may mention the following. We once had the interesting experience of visiting the toothbrush factories of Halex, Ltd., and of S. Maw Son and Sons, Ltd., two of the largest in the country. It was in the pre-nylon days, so that bristles, imported from India we believe, were employed. No doubt they were sterilized before use and were then sent to the sorting tables, which occupied much valuable space. Here well-trained girls segregated the sheep from the goats or, rather, the perfect bristle from the coloured or imperfect one, by hand. The work was rapidly carried out, of course, but it had to be done and many girls were at work. Now nylon appears in the works, and we presume the sorting tables have been cut out entirely, for nylon is a pure synthetic chemical that is received by the toothbrush manufacturer with every bristle exactly the same colour, thickness, etc. There should be no rejects or second quality at all. In passing, we wonder if the use of nylon, since it can be so readily dyed, presages the coming of the coloured bristle to match our pyjamas! No doubt the sales departments have already thought of this magnificent idea.

Another problem for the economist-geographer of the future is the changing scene in the textile world. If nylon is as remarkable as we believe it to be and surpasses real silk in some ways, what is to happen to the enormous silk industries of Japan, China and Italy when countries such as the U.S.A., Great Britain and Germany, incidentally the largest importers of finished silk ware in peace-time, can manufacture the raw nylon within their own shores from indigenous raw material in what are virtually chemical factories? The problem is more fascinating and more important from the point of view of world economics than the synthesis of the dyestuff indigo in 1880, which ruined so many natural indigo growers in India at the end of the past century.

Almost no information has crept out of the chemical laboratories regarding nylon or, rather, the polyamides for use as moulding material. Judging from the physical properties of the plastic already divulged, it would seem we are in for some pleasant surprises and, probably, a still further widening in the use of industrial plastics.

The foregoing is in the nature of a sweetening to rather technical and, to the average reader, slightly indigestible notes we give herewith. So many readers have asked for more information regarding the production of nylon that we have translated a recent article by K. Sarre in "Kunstoffe" entitled "Polyamides, Manufacture and Uses."

"Super-polyamides" of highest molecular weight are of the greatest importance for the production of synthetic fibres and plastics. The discoverer, Wallace H. Carother, of E. J. du Pont de Nemours and Co., already pointed out the possibilities in U.S.A. Patent 207,250. There are two methods to produce polyamides, (a) either from diamines with at least one free H-atom attached to each amino-group and dicarboxylic acids or their derivatives (Brit. Patent 461,237), or (b) from w-amino-carboxylic acids, their lactames or derivatives (Brit. Patent 461,236). Diamines used are tetra-, penta-, hexa-, deka-methylenediamine, and acids such as adipic, pimelic and sebacic acid. On heating, a salt is formed first, which condenses at 190 to 300 degrees C. The reaction is accelerated by continuous removal of the formed water or alcohol. It is recommended to work partly in an autoclave under pressure at higher temperatures in an inert gas to avoid discoloration at temperatures above 220 degrees C. Catalysts are generally unnecessary, although solvents (phenols) are sometimes advantageous. A typical example is the following: 26.4 parts of hexamethylenediamine, 33.2 parts of adipic acid, 60 parts of xylenol mixture (boiling range 218-223 degrees C.) are heated for 7 hours at 218 degrees C. The reaction mixture is poured into alcohol, when the precipitated polyamide forms a white crystalline powder, M.P. 250 degrees C. To obtain pale-coloured products, the use of vessels made of glass, silver, chromium, etc., and absence of oxygen is indispensable. Polyamides with good solubility are particularly valuable. Innumerable variations are possible by mixing various diamines with different dicarboxylic acids (Brit. Patent 474,999). Other variations may be obtained by using polyamides with olefine or acetylene links or with -O- or -S- bridge.

The polyamide-condensation products are at normal temperatures hard, non-transparent, colourless to brown, highly viscous with well-defined melting point between 150-270 degrees C., S.G. 1.04 to 1.08, insoluble in water and usual solvents, only soluble in hot phenols, formamide, acetic and other acids. They are not attacked by alkali, although hydrolized by strong mineral acids. Their molecular weight is between 7,000 and 20,000.

Spun fibres stretch to 200 to 700 per cent. of their original length, when an orientation of the molecule takes place, assuming a similar structure to natural cellulose and silk. There is an improvement of the mechanical properties, i.e., the tensile strength (wet) equals 90 per cent. of the tensile strength (dry). The speed with which spinning from a bath can be done is most remarkable. It is also possible to add substances to lower the melting point (Brit. Patent 501,527), or to add stabilizing agents (Brit. Patent 495,790), or to cool very quickly by adding certain non-solvents (Brit. Patents 491,111, 501,197, 504,344; U.S.A. Patent 2,137,235), or to add an opaque medium (Brit. Patent 504,714). There is also mentioned further treatment with swelling agents to improve the mechanical properties (U.S.A. Patent 2,157,117), partly in presence of sulphides or bisulphites (U.S.A. Patent 2,157,118).

The fibres can be dyed with acid dyes, exactly like silk. These fibres, for which the trade name of "Nylon" has been adopted, actually surpass the strength of silk (U.S.A. Patent 2,157,116). They may also serve as a substitute for wool (French Patent 833,755) or for sewing yarns (French Patent 843,633).

Other uses indicated are for lacquers, adhesives, plastics, binders (U.S.A. Patent 2,154,436) and electric insulating material (French Patent 838,776).

Ideas—

By the EDITOR

Collapsible Cups

The moulders of the collapsible cups shown in the accompanying photograph, Associated Resin Products, Ltd., tell me that they have been on the market for some time, that other moulders have made them also, and that I should have seen them before. *Mea maxima culpa.* I haven't, and I still think it's a good idea, especially now since metal is so rare and

picnicking, thank heavens! can still be carried out if one is careful. I was mainly intrigued in the excellence of the mould, for the annular units must be accurately made to avoid leakage of liquid.

Earthing Plates

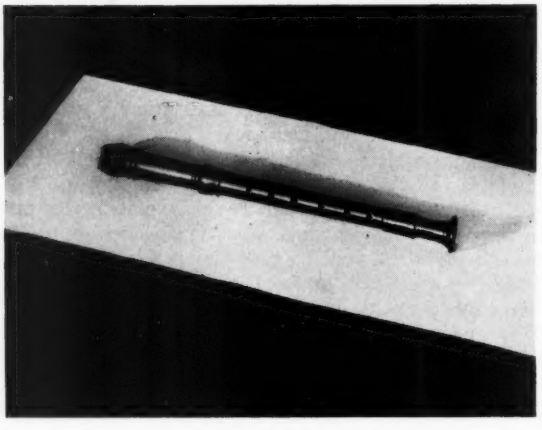
It has always struck me that even in the electrical industry, which employs so much plastic material and to which the plastics industry can be said to owe its existence, there are still greater possibilities of utilizing synthetic resins. This is true especially in war-time, and while talking recently with a well-known authority on electricity I asked him why plastics could not be used in making earthing plates. At first sight this seems a stupid question, since earthing plates must be conductors of electricity and are almost invariably made of copper. What I mean, of course, is the maintaining of the copper as an outer surface to act as the conductor, utilizing plastics merely as the main body and so saving valuable copper metal. In other words, I visualize a plastic plate, moulded or made of laminated material, furnished with thin metal strip or, alternatively, sprayed with metal. It must be remembered that it is the area of metal exposed that matters and not the thickness. As has been shown in these pages, both metal strip and sprayed metal will adhere very well to plastics if the processing is carried out properly.

I admit it would be difficult to mould the long conical type of copper earth that is so often used and which is an efficient method of earthing by contact at many points with the conducting salts in the earth. But the point shaped does not need the extreme acute angle and a cylindrical rod would prove very satisfactory. Provided with a metal point it could even withstand driving into the ground with a hammer. I estimate that, utilizing a sprayed metal surface or 2/1,000 to 5/1,000 in. metal strip, some 75 to 95 per cent. of copper could be saved.

The authority I discussed this matter with admitted that it seemed feasible and seemed quite excited over the idea. I suggest it as a war problem, but I am by no means sure that it could not be solved so as to make the plastic earth as cheap as a copper one and thus make the former a peace-time proposition.

Plastic Musical Instruments

Some time ago a Mr. Brian Hills wrote saying that, following a note of mine regarding the production of plastic musical instruments, he had bought an American recorder of this type and had found it extremely successful, especially from the point of view of tone. I did not know that a musical instrument called a recorder existed, but, on delving more closely into the subject, found that



Messrs. Fraser and Glass, Ltd., have been moulding them by injection for some time. Here is a photograph of one. So, if Mr. Hills buys more than one recorder in his lifetime he might remember there are British ones available.

Anti-shatter Films

There has been a to-do regarding the solutions that have been put on the market for the prevention of window breakage in air raids. In one instance, latex films have been condemned out of hand as being weak and subject to rapid deterioration under the action of ultra-violet light or daylight. This is scarcely fair, for both good and bad results can be obtained from rubber, and it all depends upon what ingredients, such as antioxidants, etc., are mixed with it. There has been a ramp by some, but reputable makers produce a good quality, and, moreover, some insist on a second film of lacquer over the latex to give best results. On the whole, I should have thought that a polymer, such as a "vinyl" resin, would have given best results.

PRODUCTION

Practical Information dealing with Raw Materials, Moulding and Forming of all types of Plastics—Thermo-Hardening and Thermo-Plastic—Works-Organization, New Plant and Control Apparatus

NOTES AND COMMENTS

Toy Boom

Great Britain is not normally considered the home of the toy-making industry, a title usually held by Germany and, to a lesser extent, by Japan and Austria. But ever since the high-class, mass-produced toy came into existence, the high technical abilities of this country have shown that it is as capable as any of producing these highly prized goods. What is so surprising to many is that the largest toy-making factory in the world is situated near London.

With Germany unable to flood the world with its products, we are now in an excellent position for showing our goods to many parts of the world where German and Japanese toys were widely purchased. Latest statistics show that our exports have already increased by 50 per cent. Since, too, wood and metal is so rare, change-over to plastics for many components is increased. Some toys, especially the very popular aerocraft type, are almost entirely of plastics.

American Plastics Institute

The Plastics Industries Technical Institute, which opens on the West Coast on September 16, announces the appointment of E. F. Lougee as chairman of the Board of Governors. Mr. Lougee, formerly editor of *Modern Plastics* magazine, is now in Los Angeles working with John Delmonte, technical director, completing details of the curriculum and training to be made available.

The initial educational programme embraces a thorough study of all plastic materials; their history and background; methods of classification; their relationship to various engineering and industrial fields; their nature and properties; and forms in which they are available for manufacturing purposes.

This general programme will be followed by specialized training in mould design and moulding; methods of laminating and types of materials used; methods of casting plastics and their utility; fabrication; styling and design; finishing materials; extent of applications including study of market possibilities; and methods of testing plastic materials.

Students may elect courses in specialized training to suit individual requirements. Full-time courses at Plastic I.T.I. will be based upon actual projects which students develop from blue-prints to finished products. Courses for home training will be available and may be supplemented by intensified shop practice at the Institute upon passing satisfactory entrance examinations.

Plastics I.T.I. will be housed in a modern air-conditioned building at 186, S. Alvarado Street, Los Angeles, California.

Transactions of the Institute

The Institute of the Plastics Industry has just published the papers read during the 1939-1940 session. These include (1) "Hydraulic Machinery and the Plastics Industries," by M. R. Rhodes, M.I.Mech.E.; (2) "Materials Used in Injection Moulding," by A. Hill, B.Sc.; (3) "Methods of Injection Moulding," by H. W. J. Inshaw; (4) "Moulds for Injection Moulding Machines," by J. Prior; (5) "Injection Moulding," by L. N. Jones, and (6) "Plastics as Constructional and Engineering Material," by H. V. Potter, B.Sc., F.I.C.

New Editor for "Modern Plastics"

We have received a letter from Mr. C. A. Breskin, president of the Breskin Publishing Corporation, New York, to the effect that Mr. W. T. Cruse, of the Celluloid Corporation, has assumed the editorship of *Modern Plastics*. We extend to Mr. Cruse our heartiest congratulations and assure him of our desire to co-operate with him in all ways.

Torches and Lamps

As examples of the important work being carried out by Stadium, Ltd., High Street, Ware, Herts, I have received a moulded torch and an A.R.P. Stormlite. Both are excellent manufactures, although the latter, shown on the right of the photograph, is of special interest, because the plastic body seems so robust. It is obviously made from a shock-resisting moulding powder, apparently of the fabric impregnated type. Those unacquainted with this type of lamp will realize that there are two lights, one which can be employed by reversing the lamp so that the light shines downwards when carried.

Forming Moulds by Spraying Metal

This account is a brief summary of the method fully described in the June issue of "Modern Plastics"

NEWS has just come to hand from the United States regarding a revolutionary method of forming moulds by spraying metal on or around a form or matrix and then removing the sprayed-metal shell, which, with suitable backing, serves as the cavity of a mould. This process has been under development for a number of years and now the Metallizing Engineering Co. Inc. has perfected it to the point where production moulds have to be made. The greatest advantage of the process, perhaps, and certainly the most obvious, lies in the fact that finely engraved lines and detailed patterns can be accurately reproduced without the necessity of engraving them in steel.

The moulds are made by spraying metal, such as hard steel or stainless steel, bronze or any other metal which can be obtained in wire form, on to a master of the object to be moulded. The metal spray gun used to do this work, and manufactured by the same company, is essentially a small portable foundry. Three gases—acetylene, oxygen and compressed air—are used in its operation. Part of the compressed air is used to drive a small air turbine, which feeds the metal in wire form through the gun. The wire is melted as it passes through the acetylene flame and then blown out in very finely divided molten particles and deposited upon the model which is being sprayed.

Example of the work carried out by the new metal-spraying process perfected in America by the Metallizing Engineering Co. Inc. Note the fine detail possible by the method.

The model may be made of wood or plaster, which is much easier to engrave than steel, or it can be made of plastics, stone, metal or almost any other material with a smooth, hard surface against which the metal can be sprayed. The sprayed cavities require no heat-treating, it is said, and the hardness of the mould depends upon the metal sprayed. Some of these moulds are being run now and have been reported to stand up exceptionally well in test performance. The test runs have been sufficiently rigid to determine the practicability of using moulding pressures sufficiently high for the successful moulding of thermo-setting plastics.

Backing up the shell to give it stability to withstand plastic-moulding operation is done by either of two methods—casting or spraying. In either case the mould is finished by turning in a lathe to get a perfect surface to contact the chase and the base is either ground or machined to fit.

The time required for forming the mould by this ingenious process is exceedingly short, when compared with ordinary machining operations, unless, of course, the mould is very simple in form. The spraying time given for a small and comparatively simple button-embossing die was 4 minutes, and it required approximately 5 minutes of spraying time to make the duplicate die from the negative. Another die, which the manufacturers were told by the moulder that it could not be made economically by any other method, required about 120 hours to produce. Only 14 hours of this time, however, was needed for the actual spraying, the balance being used in getting the part lined up true, getting a satisfactory model, etc.

Extruded Ethyl Cellulose

THE Dow Chemical Co., Michigan, U.S.A., has just announced the availability of ethyl cellulose, Ethocel, in extruded form. This material is claimed to be particularly suitable for furniture manufacture and already one leading American manufacturer, Ficks Reed Co., is making porch furniture of this material. Ethyl cellulose resists weather, light, heat and ageing, extrudes with a high gloss and retains its finish under every ordinary condition. It can be extruded in ribbons or rods, solids or tubes, to meet practically any specifications, such as are required for the seats and backs of porch furniture and the interior trim of automobiles. There are practically no limitations as to colour. It is reported that a great deal of interest is being shown in this development by hotel managements and firms manufacturing for the catering trades. For roof gardens, etc., there is a growing demand for 100 per cent. weather-resisting and yet fully attractive furniture and, according to all accounts, extruded ethyl cellulose should give satisfaction.

Extrusion is commonly effected by either the positive pressure piston-type machine or the screw type, the latter being the most commonly used in the U.S.A.

Essentially, the screw-type extrusion machine consists of a horizontal tube which contains a closely fitted screw of constantly diminishing pitch. This tube is jacketed to provide for the circulation of a heating medium. An opening through the top of the tube and jacket, at the drive or low pitch end of the screw, provides a point for feeding the plastic material into the screw. The die is fixed in the centre of the head at the discharge end of the tube.

Inquiries and Answers

(In Which is Included General Correspondence)

Moulding Powders for Export

"Aeco" House,
C/r Miller and Eighth Sts.,
New Doornfontein,
Johannesburg.

The Editor, *Plastics*.

Dear Sir,—We desire to obtain the names and addresses of manufacturers of moulding powders with—

(i) A bituminous base.
(ii) Asphaltic base.
(iii) Asbestos base.
(iv) Fabric base.
(v) Paper base.
(vi) Woodflour base.

With their respective properties for future reference, together, if possible, with samples.

Our agents in England are Messrs. Mitchell Cotts and Co., Ltd., Winchester House, Old Broad Street, London, E.C.2, to whom you may refer.

PLASTIC INDUSTRIES (PROPRIETARY), LTD.

[EDITOR'S NOTE.—We presume the first two named contain no synthetic materials, but are the usual mixes employed for making accumulator boxes, overhead-line transmission insulators, terminal blocks, etc., which do not come into contact with oil. This type of plastic is usually manufactured by the concerns making the finished mouldings and, so far as we know, is not marketed in a manner similar to the synthetic moulding powders. There is a considerable amount of literature on their manufacture available. The production is comparatively simple, the technique involving a mixture of bitumen and fillers which may be asbestos, slate dust, etc., by heating and mixing in oil-jacketed pans.

The remaining moulding powders refer, we presume, to the phenolic and urea types. Will those concerns interested in export business please write direct?]

Bonded Plywood

Southampton.

The Editor, *Plastics*.

Dear Sir,—We should be glad to know whether you are in a position to suggest alternative materials and probable sources of supply of plywood backed by synthetic resin glue, which we are having difficulty in obtaining.

THE BRITISH POWER BOAT CO., LTD.

[EDITOR'S NOTE.—The chief suppliers of this type of material are Bakelite, Ltd., New Insulation Co., Ltd., Moulded Components (Jablo), Ltd., Jicwood, Ltd., Bushing Co., Ltd., and perhaps others listed on p. ii of our directory, under "Laminated Plastics." We can give no suggestion as to alternative materials, since the inquirer does not disclose the application.]

Plastic Stoppers

An inquirer, who wishes to remain unnamed, asks us if we can supply the names of moulders of hot water bottle stoppers in synthetic resin or other plastic materials. He adds: "The standard metal stopper which we normally use is enclosed, together with a plastic stopper we tried out some years ago. We

believe other plastic manufacturers have produced these stoppers and if the sources of supply are known to you, we would appreciate your recommendation."

[EDITOR'S NOTE.—We understand that Standard Insulators, Ltd., at one time did so, and that there are available special moulding powders for the job, but, so far as we know, there is no present manufacture. Should there be such production we should be glad to put the inquirer in touch with the moulders.]

Metal-sprayed Plastics

Building Research Station.

The Editor, *Plastics*.

Dear Sir,—In connection with inquiries that are being made at this station on the use of plastics for building purposes, I am interested in the article on "Metal Sprayed Coatings on Plastics" in your June issue and should be glad to have further information on the durability tests to which reference is made. Perhaps you will be good enough to put me in touch with your contributor, Mr. E. E. Halls.

FOR DIRECTOR OF BUILDING RESEARCH.

[EDITOR'S NOTE.—We are glad that this method of treating plastics, which we have so long advocated, is arousing some interest in important circles, and have put the inquirer into touch with Mr. Halls. At some future date we hope to publish further results of investigations as they are made available.]

Synthetic Adhesives

London, N.W.6.

The Editor, *Plastics*.

Dear Sir,—I should be grateful if you would kindly advise me on the following. I am in need of a book or review on Synthetic Adhesives. If you can secure one for me, please let me know details.

If there is no such book, please inform which is nearly akin to it. I have read the two articles on "Synthetic Adhesives" in the March and April, 1940, issues of *Plastics* and am anxious to know more about them, especially from the aeronautical application point of view.

R. S. KHOT, M.A., M.Sc.

[EDITOR'S NOTE.—We fear we know of no book that deals with what the inquirer wants. The books on plastics so far published avoid anything more than casual mention of the new adhesives, while books on adhesives mention nothing, or little, of the synthetic type. The reason is, of course, that they have only appeared on the market in the past five years or so and that development is continuous. The best sources of information are those issued in practical pamphlet form by the makers, Aero Research, Ltd., Duxford, Cambridgeshire; Bakelite, Ltd., Brackley Lodge, Brackley, Northamptonshire; and British Industrial Plastics, Ltd., 1, Argyll Street, London, W.1.]

Polystyrene Films

Glasgow.

The Editor, *Plastics*.

Dear Sir,—We have done some work on the formation of polystyrene films, and to obtain a tough flexible type, like cellulose nitrate, have used tricresylphosphate as a plasticizer. There occasionally forms a deposit of "crystals" and the film is tacky. Can you suggest a remedy? G.H.

[EDITOR'S NOTE.—It appears that the inquirer has followed nitro-cellulose lacquer technique too closely. It is fairly clearly laid down that, following the theory of solvents, the solvent should resemble the solvate as closely as possible in polarity. Thus, since we believe polystyrene is non-polar, a plasticizer such as chlorinated diphenyl or dibutylphthalate should be more suitable. The "crystals" may be due to a portion of the resin being thrown out of the solution and tackiness due to the large quantity of plasticizer necessary to make the initial solution. A good book to read on this subject is Jordan's "Technology of Solvents," published by Leonard Hill, London.]

Women in Moulding Shops

St. Helens.

The Editor, *Plastics*.

Dear Sir,—I have just been reading, with the usual interest, the July copy of *Plastics*, and I noted your remarks on page 168 regarding Women Moulders. You may be interested to know that we have employed a proportion of women moulders on our "Compression" presses for the past three years, and although they are not as satisfactory as men when it comes to intricate work, and they cannot, of course, handle heavy work, they are, on the whole, quite satisfactory. I should perhaps mention that by far the majority of our jobs are automatic, i.e., the tool is tied in the press.

G. F. BASSETT.
Ashdowns, Ltd.

Plastic Moulds

London, W.C.2.

The Editor, *Plastics*.

Dear Sir,—I have read in the July issue the letter from F. W. Hawkins, and I think that he might be interested in a method which I employed many years ago to produce some hard rubber mouldings. I first made a plaster cast, using the article it was desired to reproduce as the master. This plaster cast was treated by indurating it with a liquid phenol-formaldehyde resin. The mould was made in two halves in the usual way and stood up to the temperature and pressure surprisingly well, producing some hundreds of articles. As the moulds are so cheap to reproduce, their life is a matter of little consequence.

This method or an elaboration of it might help your correspondent. H. C. BRYSON.

Toolmakers and the War

In our July issue we published some general notes on the war effort of our industry and some of the conditions under which moulders were working.

As for the toolmakers, they are, on the whole, more settled than they were six months ago, presumably as a result of the efforts of Messrs. Morrison and Bevin. The following letters are typical of those we have received:—

Dear Sir,—We thank you for your letter of the 12th instant and in reply would state that the difficulty we were experiencing in regard to supplies of steel has now eased a little, owing to our working in conjunction with the Air Ministry.

With regard to the labour problem—so far we have only lost one employee by being enticed away by another concern; this was reported to the Air Ministry and we were informed that steps are being taken to avoid a recurrence.

BARBER AND DUFFY.

Dear Sir,—Thank you for your letter of June 12 re steel and employer difficulties.

The question of steel is not unduly worrying to us as most of the work we have on hand at the present is for the various Government Departments, which, of course, carry priority and enables us to get supplies; we have undertaken other work, apart from the moulding trade, for the Government Departments.

Our employees have proved very loyal and remained with us, which we appreciate, although we have heard of troubles in other places. Many advertisements have appeared in the local Press calling for skilled workers, of which there is an obvious shortage.

W. B. COLDWELL AND SONS, LTD.

Dear Sir,—In reply to your letter of the 13th inst., the position referred to has now crystallized, and while we have not been able to increase our labour, we are assured of being able to retain our existing personnel.

We are now able to organize our facilities for a maximum output, and together with the willing co-operation of all our employees working longer hours, enables us to concentrate on urgent orders.

DORMER AND WADSWORTH, LTD.

Dear Sir,—The steel question is not affecting us so much at present largely because we have swung over almost entirely to Government work for which it is possible to obtain material either from the steel suppliers direct or through the main contractors.

As regards labour, we have been fortunate in retaining all our skilled workers, but are releasing some on loan by arrangement with the Labour Exchange where vital national requirements make this desirable. FOX AND OFFORD, LTD.

The question of metal inserts for the moulding industry is still bothering many. Supplies are not coming in with the required celerity. This would appear, on the face of it, an interesting comparison between the relative production of metal and plastics.

TRADE AND PERSONAL NOTES

Broadcast Music to Help Speed Up Production

The General Electric Co., Ltd., has just sent us an interesting brochure dealing with the above subject. "In war industry, output—and more output—is the chief demand, but the very urgency of the demand requires consideration of the means by which it may be attained." So reads the introductory matter to the Emergency Report No. 1 on "Industrial Health in War," prepared by the Medical Research Council Industrial Health Board.

In attaining increased efficiency and higher output the problems that have to be faced are often those connected with mass production. Although in many cases skilled labour is employed the processes are chiefly repetitive, and, being repetitive, tend to produce boredom and fatigue because of their monotony.

It is a matter of primary importance, therefore, that monotony shall be reduced. On this subject the "Summary of Recommendations" in the emergency report provides inspiration—one recommendation being to "Take measures to alleviate boredom by varying the work and by providing distractions, such as music, that do not too greatly alienate the attention."

As the B.B.C. has also begun broadcasting a series of special programmes entitled "Music While You Work," it would seem that official opinion on high value of music for this purpose has now become unanimous.

Many tests have been made as to the percentage increase in production obtained when music is broadcast, but as results vary according to the type of work involved it is difficult to quote figures that can be used as a measure. According to Report No. 77 entitled "Fatigue and Boredom in Repetitive Work," which has also been made by the Medical Research Council Industrial Health Board, the average rise in production after installation, however, is usually not less than 6 per cent.

It should be explained at this juncture that the apparatus required for the radiation of music to employees is known as sound reproduction equipment. A complete installation of this kind usually includes provision for radiating gramophone music, broadcasting B.B.C. programmes, and general announcement facilities.

The apparatus required for radiating gramophone music consists of a playing desk and an amplifier, these being connected, via a control panel, to speakers placed in shops or workrooms as required.

It has been found that light music, especially dance music, is preferred by most workers, and as a rule orchestral numbers predominate. The brisker rhythms are, according to industrial psychologists, more likely to encourage speedy work.

There is a great deal of difference of opinion as regards the best times at which to radiate music, but it does appear advisable to intersperse the day with several periods of music of not less than 30-45 minutes' duration. Employees are, of course, likely to be at their peak efficiency first thing in the morning, and will again work better just before mid-day break, or before knocking off, as the anticipation of these events tends towards accelerated activity. Mid-morning and mid-afternoon seem to be indicated, therefore, as ideal periods for broadcasts.

Programme items can, for instance, be varied to a greater extent, and the appeal of records of popular dance tunes given longer life. Another benefit is that vital news and special announcements can be broadcast to employees without disorganizing production.

The apparatus needed for general announcement purposes again comprises an amplifier and speakers, but these are connected to microphones at strategic points, via a control panel.

It is usual for a microphone to be placed in an executive's office, or central control-room, and a second wired to the telephone switchboard. Other microphones can be added as felt to be necessary, but are not usually vital.

By this means an executive can call any member of his staff via the speakers in the factory should the latter be away from his usual working place. The executive can do this either directly from his office, or if he himself is away from his own office, by telephoning the operator and asking her to broadcast a call. In large works a great deal of time can be saved in tracing men by this method. Instructions and announcements of a general nature can, of course, be issued in the same way.

A further important purpose to which a system of this kind can be put is that in connection with A.R.P. By extending the loud-speaker circuits to include air-raid shelters and installing a microphone in the central A.R.P. control-room, a scheme that will prove invaluable is provided.

Instructions can then be issued by the chief warden from the control-room to employees in all parts of the factory, or in the shelters themselves. Movement to and from the shelters from working places can be speeded up, and order more easily maintained. The minimum amount of dislocation of production effort entailed during fire drills and false alarms is also thus ensured. It is interesting to note in this connection that the psychological reaction to messages and instructions issued by a familiar voice of the works chief warden can do much to maintain morale in an emergency.

Colt Ventilation, Ltd., has sent us some details regarding its Colt Black-cut Ventilator. This ventilator (covered by provisional patents) is offered by Colt Ventilation, Ltd., whose scientific industrial ventilators are known throughout the world. The Government authorities who are responsible for testing and approving any such device, unanimously subscribe to its efficiency, and had already placed substantial orders prior to it being placed on the market. The essential advantages claimed for the Colt Black-out Ventilator are: unrestricted air flow; complete obscuration of light; unobtrusive, being only 1¼ in. thick; simple in construction; no moving parts; requires no attention while in use; completely resistant to weather; low cost; easily and quickly fixed anywhere.

Dale's, 62, Bonchurch Road, Elm Grove, Brighton, 7, has informed us that they are now able to take on all orders involving the cutting of plastic rod or sheet.

Case Development Co., Ltd., formerly of South Street, Greenwich, has now moved to Kangley Bridge Road, Beckenham, Kent. The new factory is three minutes from Lower Sydenham Station.

J. H. Sankey and Son, Ltd., Ilford, Essex, has just forwarded us particulars of an entirely new material, namely, Sankey's Super Acid-Resisting Cement. This material is supplied in the form of a fine powder and has to be mixed with Sankey's Acid-Resisting Solution. The mixing is done simply and quickly; the plastic cement then obtained is applied in the usual way, i.e., for jointing, pointing, patching and rendering. It adheres strongly to brick, tile, earthenware, stone, concrete, iron, etc.

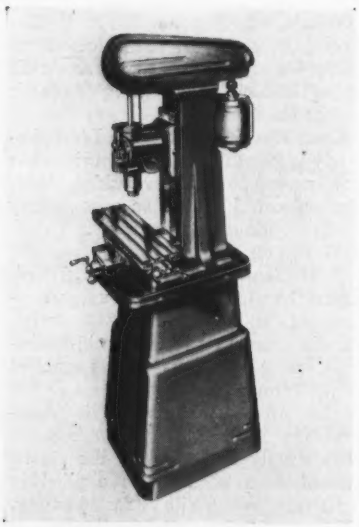
NEW MATERIALS—NEW PLANT—NEW METHODS

Vernon Vertical Machine Combines Miller and Borer

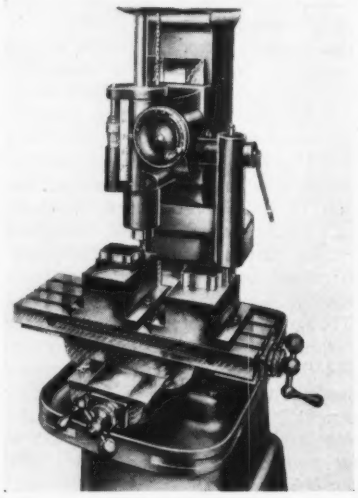
The "Vernon" combination vertical milling machine and jig borer developed by Machinery Mfg. Co., Dept. 10, P.O. Box 155, Vernon Branch, Los Angeles, Calif., has been designed especially for work on jigs, fixtures, dies and general milling operations. It can be used for laying out various jobs requiring high accuracy and can be equipped with dial indicators and measuring plugs for precise work. A profiling attachment can be used for duplicating work within the range of the machine.

The machine has a maximum distance of 10½ ins. from the top of the table to the bottom of the spindle. The drill is arranged so that the slow feed is provided by handwheel, graduated to 0.001 in., or the slow traverse can be disengaged and a rapid one engaged by merely turning a knurled knob. The rapid one-to-one hand traverse greatly increased speed in drilling operations, also in milling out cavities for dies and similar parts. Spindle drive is equipped with back gearing and provides eight spindle speeds.

Specifications:—Overall height of floor model, 71 ins.; floor space required, 38 by 33 ins.; height from floor to table top, 41 ins.; maximum collet capacity, ½ in.; spindle speed range, 250 to 4,200 r.p.m.; table size, 6 by 21 ins.; longitudinal table travel, 12 ins.; cross table travel, 6 ins.; movement of sliding head, 10½ ins.; distance from centre of spindle to column ways, 6 ins.; drill travel 3 ins.; net weight of floor model, 700 lb. The bench model, without pedestal, weighs 500 lb. A ½ h.p. 1,750 r.p.m. motor is required to drive this machine. The Broadway Engineering Co., Ltd., Carlisle Road, Hendon, N.W.9, is the sole agent.



General view of the Vernon combination vertical milling machine and jig borer.



The sliding head of the Vernon vertical milling machine and jig borer is so constructed that this attachment can be easily and quickly engaged and disengaged.

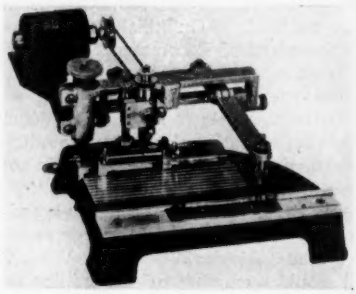
New Injection Press

The new improved hydraulic injection moulding machine for plastics, designed and built by the Watson-Stillman Co., is devised for faster operation, increased capacity and production, and economies in operation and maintenance, according to a recent release. One of its most distinctive new features is the zone heat control which provides ingeniously distributed heat, giving a greater plasticizing capacity to the heating cylinder. Large opening (24 ins. maximum) between die plates, with adjustment of 18 ins. on the clamping end, allows for the accommodation of dies 6 ins. thick and up. The toggle-clamping device affords positive clamping of dies having up to 125 sq. ins. projected area. Floor space is 196 by 45 ins.

Two material cylinders are available for use with this machine. The maximum weight of material injected per cycle with the 2$\frac{3}{16}$-in. cylinder is 6 oz. at a pressure of 50,000 lb. per square inch. With the 2¾-in. cylinder the maximum weight is 8 oz. at a pressure of 32,000 lb. per square inch. The stroke of the injection plunger is 9 ins.; speed of injection plunger 150 ins. per minute. Arranged for full automatic and manual control.

The Auto-Engraver

From America comes word of a new machine called the Auto-Engraver, designed to reproduce letters, names, designs, emblems and signatures on small plastic and metal articles. The machine is claimed to cut smooth lines on flat or round surfaces rapidly and with depth of cut controlled. Letters are engraved from master type furnished with the machine and include both block and script founts. The machine weighs 12 lb., is 8½ ins. by 11 ins. by 7 ins. high and is motor operated on A.C. or D.C. current.



New Laboratory Pump

W. Edwards and Co. (London), Ltd., Allendale Works, Southwell Road, Loughboro' Junction, London, S.E.5, has forwarded us its new technical catalogue describing the new metal water jet pump introduced a short time ago. This company states that the pump has met with such success and enthusiasm that it is believed to be well on the way to become a standard laboratory fitment. Its success is due, chiefly, to three reasons: (1) the exceptional performance ensured by the unique jet design; (2) the moderate prices in times of increasing costs, and (3) the tremendous need for a first-class British pump—hitherto the majority of these pumps was imported.